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(54) A flame arrestor

(57) A flame arrestor comprises a housing (2) having an inlet (3) and an outlet (4). A flame barrier element is disposed in the housing (2) and comprises annular plates (6) defining passages between them. Fluid flowing through the housing passes through the passages between the plates. Cleaning blades 8 are located between adjacent plates and are movable by a common spindle 9 to dislodge any material accumulated in the passages.

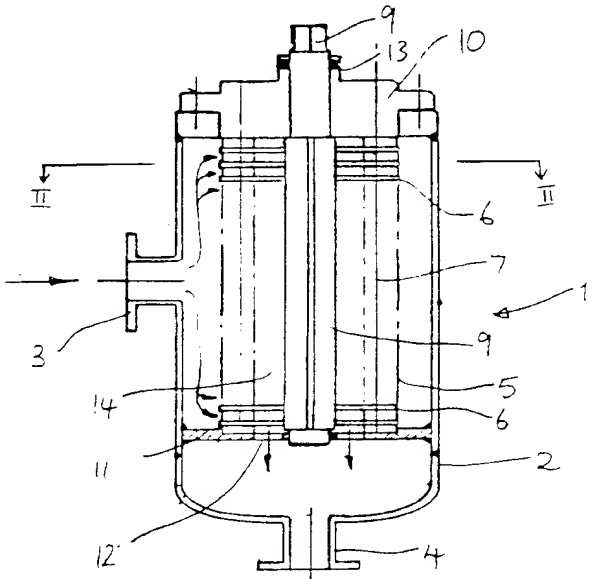

Figure 1

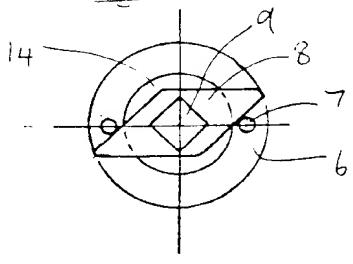

Figure 2

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The drawing(s) originally filed was/were informal and the print here reproduced is taken from a later filed formal copy.

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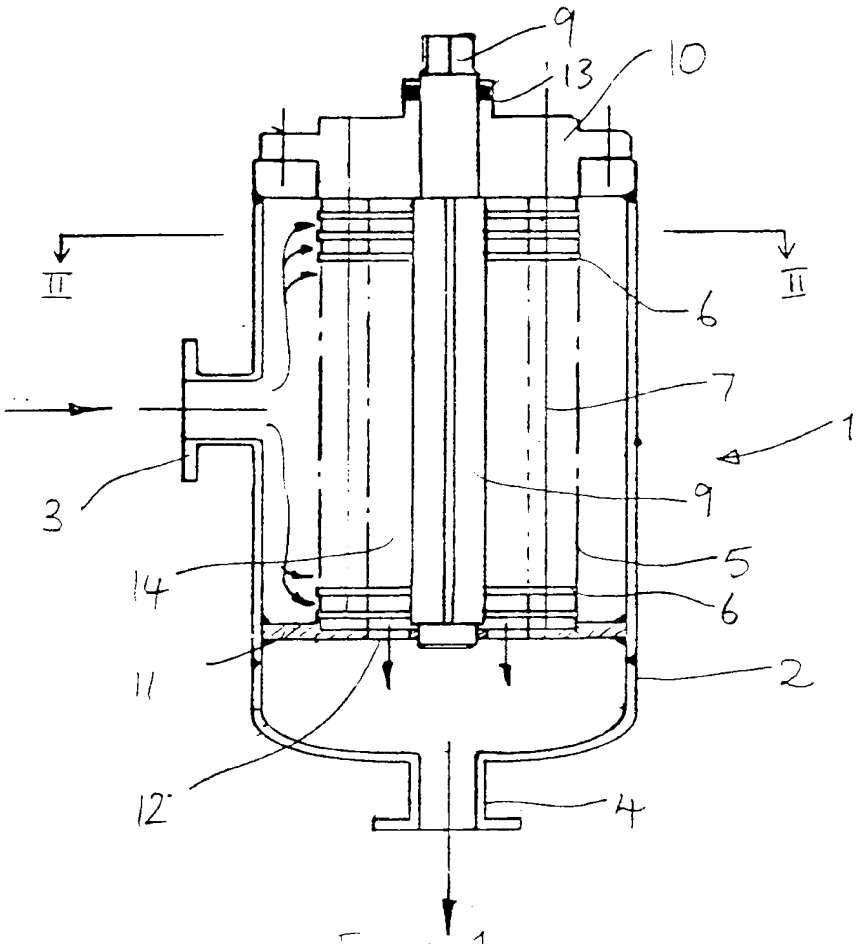

Figure 1

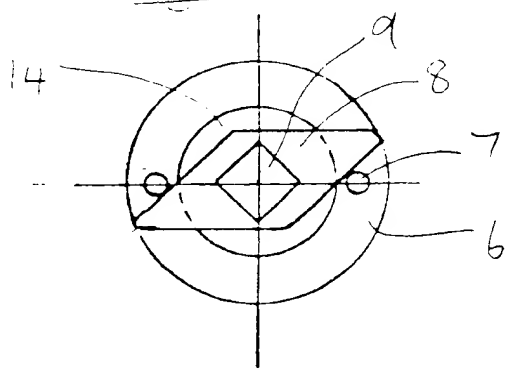

Figure 2

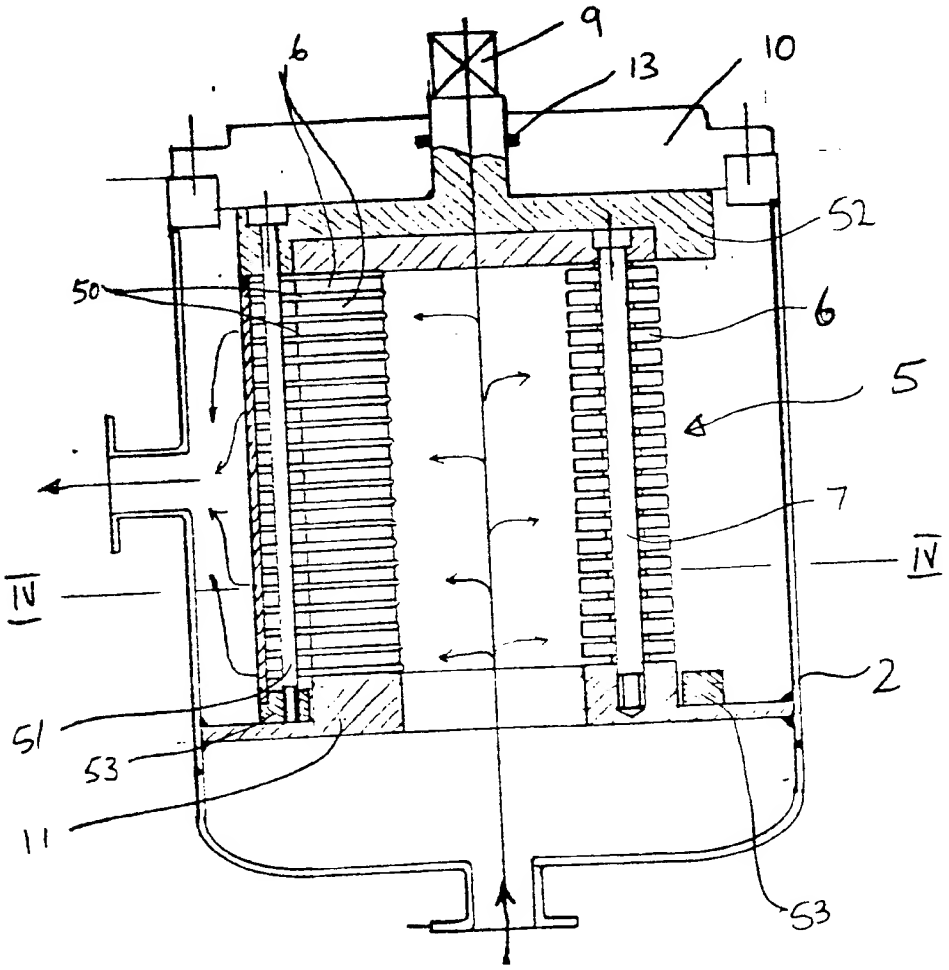

Figure 3

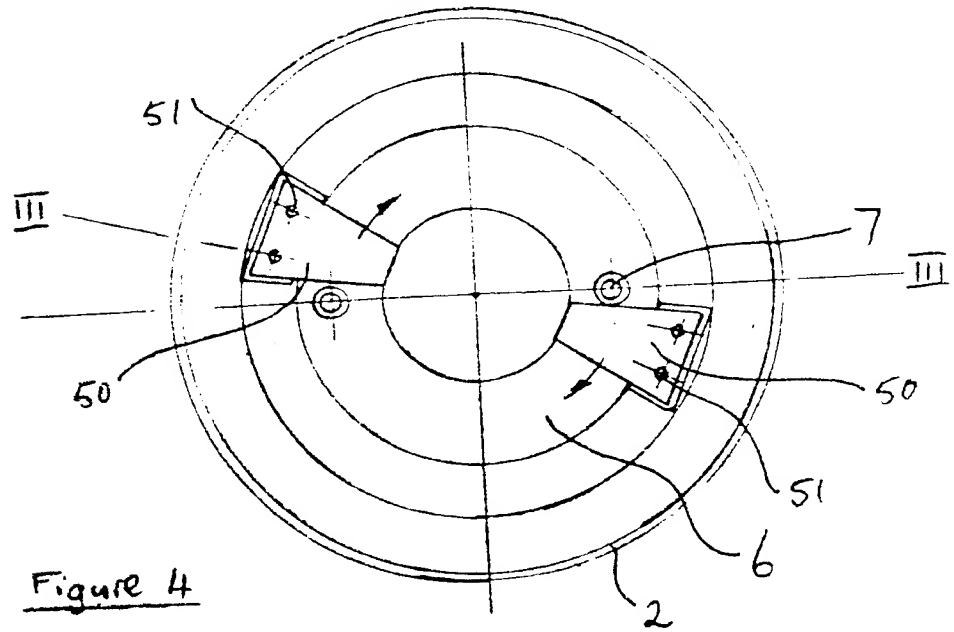

Figure 4

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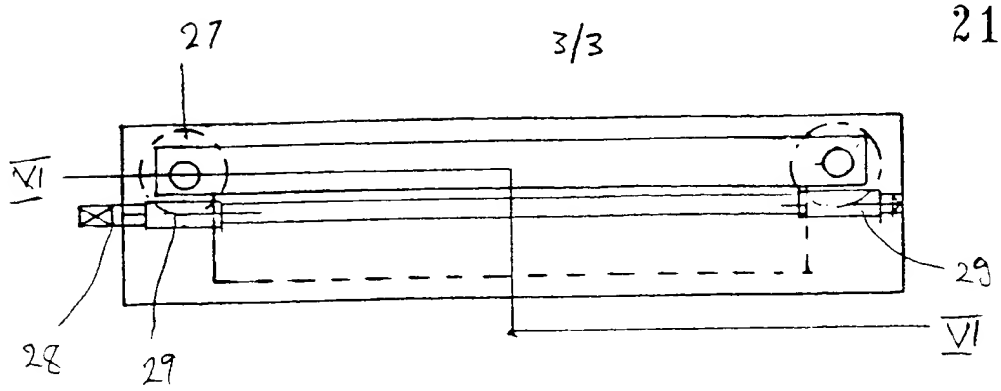

Figure 5

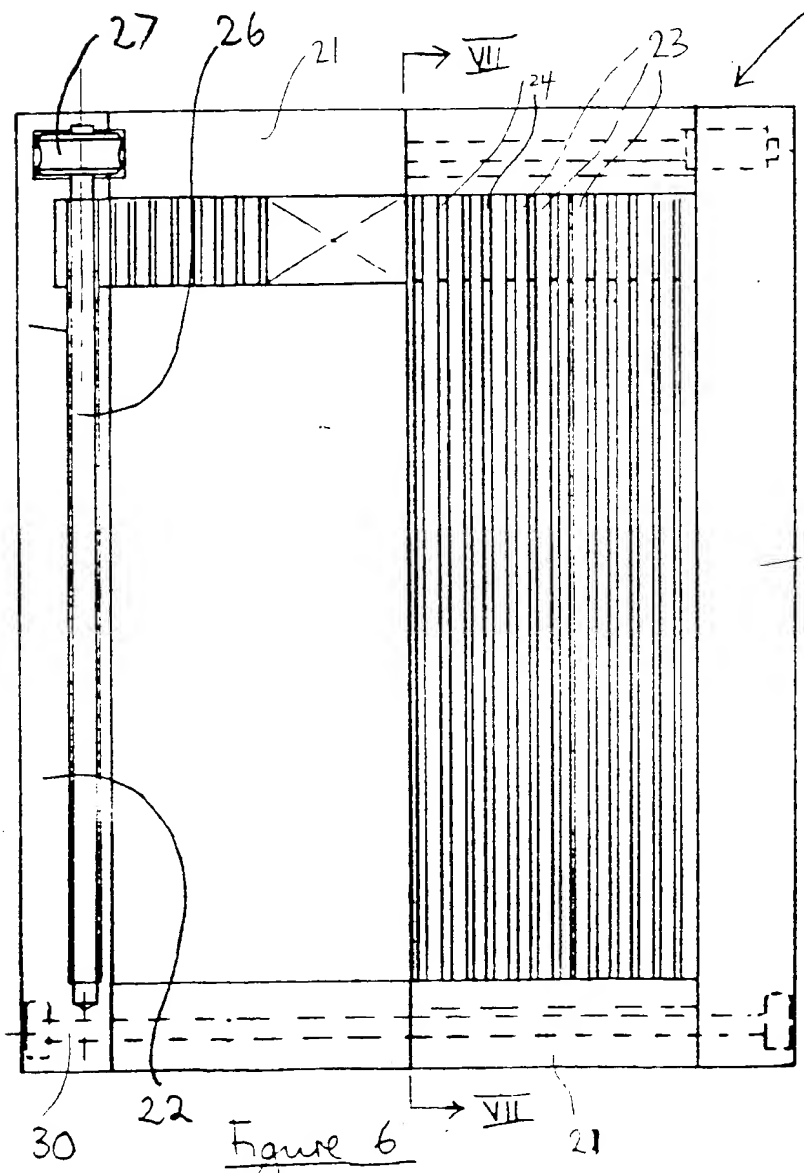

Figure 6

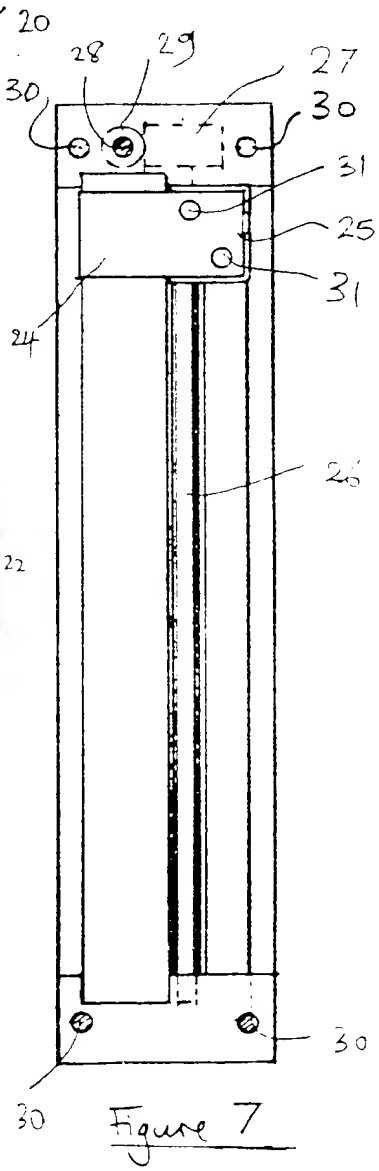

Figure 7

SPECIFICATION

A flame arrestor

This invention relates to a flame arrestor and is more particularly concerned with a flame arrestor which is cleanable *in situ*.

The purpose of a flame arrestor, sometimes known as a flame trap, is (a) to extinguish flames which accidently occur in, or at the ends of, pipes and ducts and (b) to prevent such flames being transmitted along, out of or into such pipes or ducts. The flame to be extinguished may be travelling at detonation velocity. A conventional form of flame arrestor comprises a housing containing an element which is assembled from plates. The plates are spaced apart from each other so that gas passing through the flame arrestor passes only between the plates. The element acts as a barrier to flame.

"Health and Safety Executive" TM12, Paragraph 97 lays down certain requirements to be met by a flame arrestor which is to be installed in the exhaust line of a diesel engine for use, for example, in coal mines. One of these requirements is that the element of the flame arrestor should be readily removable from the unit for inspection, cleaning and overhaul. Such a requirement is necessary for the reason that deposits build up between the plates of the flame arrestor very rapidly. The flame arrestor has to be capable of being dismantled so that the plates can periodically be cleaned of deposits. The French (CHERCHAR) and West German (PTB) safety regulations define different flame arrestor dimensions.

Separate cleaning of the plates after removal from the unit has, until now, been essential, particularly when flame arrestors are used in dirty gas streams such as diesel engine exhaust lines where the passages between the plates very quickly become blocked.

According to the present invention, there is provided a flame arrestor comprising a housing having an inlet and an outlet, a flame barrier element defining a plurality of passages which are narrow relative to the inlet and outlet, the flame barrier element being disposed so that fluid flowing through the housing passes through the passages, and cleaning means which is movable in the passages to dislodge material accumulated within the passages.

The fluid flowing through the housing is preferably a gas. The gas will carry dislodged material downstream away from the flame arrestor.

In one embodiment of the present invention, the passages are defined between spaced-apart plates, and the cleaning means comprises a series of spaced-apart blades mounted on a carrier, each blade being associated with a respective passage between adjacent plates. The blades preferably "float" on the carrier such that they align with the space between the plates with which they are associated.

Conveniently, in this embodiment, each plate is in the shape of an annulus. The assembly of annuli defines a central passage which communicates with the outlet of the arrestor while the inlet communicates with the interior of the housing outside the annuli. Consequently, fluid flowing from the inlet must pass through the assembly of annuli before exiting via the outlet. The carrier of the blades may be mounted centrally of this passage in which case movement of the blades is a rotary motion.

Alternatively, in order to overcome problems which may arise when the carrier is mounted centrally of the passage, the carrier may be provided outside the assembly of elements.

In this embodiment, there may be more than one blade associated with each space between the plates. Preferably, there are two blades associated with each space between the plates. The blades should be of such a shape and size that they do not obscure a large portion of the plates, yet they must be large enough to resist breaking when hard deposits between the plates are encountered.

The assembly of plates may, in this embodiment, be held together by two tie bolts, and spaced-apart by spacers. It is, however, to be appreciated, that two, three or more than three tie bolts can be used. In order that the cleaning means can clean a substantial portion of the plates without inconvenience from the tie bolts, the blades may be rhomboidal or of an elongate diamond shape.

Typically, the carrier of the blades is provided with a handle by which the carrier and blades can be rotated. The handle protrudes through, and is sealed with respect to, the housing whereby rotation of the cleaning means is effected from outside the housing.

In another embodiment of the present invention, the spaced-apart plates are each of an elongate rectangular shape and are disposed generally parallel to the direction of flow of fluid through the arrestor.

In this embodiment, the blades of the cleaning means are in the form of fingers which are capable of moving axially with respect to each other (i.e. they "float") although they are held together such that they cannot move rotationally with respect to each other. Each finger is associated with a respective passage through the flame barrier element. The movement of the cleaning means, in this embodiment, may be controlled from outside the housing by means of a mandrel which is geared to at least one lead screw along which the cleaning means is movable. Alternatively a lever mechanism could be used to control the movement of the cleaning means.

Control of the movement of the cleaning means may be effected manually, hydraulically,

pneumatically or electrically. The use of jacks, linear actuators, levers, and cams is contemplated in the actuation of the cleaning means to remove the accumulated material.

Although reference has been made above to the use of blades moving in the passages of the flame barrier element to clean the passages, it is to be appreciated that the blades could be replaced by wires or other cleaning elements which move in the passages.

In addition, the blades may be oscillated to give a "sawing" motion as the blades traverse the passages.

Although, in a manually operated system, the cleaning means will be moved periodically by an operator, it is to be appreciated that actuation may be effected automatically at random or timed intervals or after a pre-set lapsed operating time. In addition, a differential pressure switch may be installed across the flame arrestor to sense increased back pressure indicating the accumulation of material in the passages. This switch would signal the cleaning means to be actuated thus automatically preventing a build up of material beyond a certain point.

The flame arrestors of the present invention should normally be constructed following the accepted guidelines. Thus, all gas entering through the inlet must pass through the passages before reaching the outlet. Further, the assembly of elements must comply with tested and approved designs. These guidelines lay down specific requirements for all the width and length of the passages and the distance between them. In addition, any flanged joints of the flame arrestor should meet specified flame path and gap requirements. This is to ensure that a flame cannot escape through weaknesses where the duct or pipe is flanged to the flame arrestor. Moreover, the housing of the flame arrestor should be designed to contain detonation pressures without permanent deformation. These pressures are presently set at 10 bar for engine inlet and exhaust lines. Finally, there should be no penetrations of the housing upstream of the assembly of elements of the flame arrestor.

The flame arrestors of the present invention are suitable for use in many different installations. By way of example, they can be installed in pipe lines on oil rigs where explosive gas is present, pipe lines in chemical plants, or in diesel engines of any size. The fluid which will be flowing through the flame arrestor may be a low flash-point gas; an exhaust gas containing flammabie components; chemical vapours or gases; flue gases; and any other flammable, dangerous gases.

For a better understanding of the present invention, and to show how the same may be carried into effect, reference will now be made, by way of example only, to the accompanying drawings in which:

Figure 1 shows a partly broken away side view of one embodiment of a flame arrestor according to the present invention;

Figure 2 shows a section on the line II-II of Figure 1;

Figure 3 shows another embodiment of this invention, partly broken away on the line III-III of Figure 4;

Figure 4 shows a section on the line IV-IV of Figure 3;

Figure 5 shows a side elevation of another embodiment of a flame arrestor according to the present invention;

Figure 6 shows a section on the line VI-VI of Figure 5; and

Figure 7 shows a section on the line VII-VII of Figure 6.

The flame arrestor 1 shown in Figure 1 comprises a housing 2 having an inlet 3 and an outlet 4. The flame arrestor also comprises a flame barrier element 5 of spaced-apart plates 6 disposed in the fluid flow path (shown by arrows) through the arrestor 1. In addition, the arrestor 1 comprises a cleaning means having a series of spaced-apart blades 8 mounted on a mandrel 9 in a floating manner, i.e. with limited axial play. Thus, the blades 8 may move axially with respect to each other but they are prevented from rotating with respect to each other by virtue of the mandrel 9 having a non-circular (in this instance, square) cross-section. The housing 2 is provided with a cap 10 and, internally of the arrestor, there is provided a diaphragm 11 which also serves as a mandrel guide.

Figure 2 shows a single annular plate 6 of the assembly and the blade 8 held on the mandrel 9.

The assembly of spaced-apart annular plates 6 is held together by tie bolts 7 which pass through corresponding holes in each plate 6. The plates are spaced-apart by spacers (not shown). In this embodiment, there are two tie bolts 7 situated diametrically opposite each other. The tie bolts 7 secure the flame barrier element 5 in the flow path of gas through the arrestor 1. At one end, the tie bolts 7 are secured to the cap 10 and, at the other end, the tie bolts are secured to the diaphragm 11. The diaphragm 11 has an opening 12 through which gas flows to the outlet 4. The cap 10 is removable to permit access to the interior of the housing 2 and the element. Thus, loose material in the arrestor 1 can be periodically removed, for example, every six months.

Each blade is positioned on the mandrel 9 to project into a respective passage defined between the annular plates 6. The mandrel 9 is mounted centrally of a passage 14 defined by the annular plates 6 and is supported at one end by the diaphragm 11 and at the other end by a bearing in the top plate 10. The mandrel 9 passes through the top plate 10 and is sealed with respect to the top plate by a seal 13. With reference to Figure 2, it can be seen that the blades are of a diamond

shape. This shape of blade ensures that material over substantially the whole area of each element 6 can be dislodged when the mandrel 9 is rotated back and forth, while leaving unobstructed as much of each passage as possible. Cleaning is effected by operating the mandrel 9 from outside the housing 2. The movement will, in this embodiment, be an oscillatory motion, the blades sweeping backwards and forwards over an angle of about 180°. The operation of the mandrel may be accomplished either manually or automatically as mentioned above.

With reference to Figures 3 and 4, there is shown a flame arrestor 1 similar in construction to the flame arrestor shown in Figure 1. In the embodiment shown in Figures 3 and 4, however, the blades 50 are supported at their outer edge regions and held on bolts 51. The blades 50 float in order to ensure that they align correctly with their respective space betwen adjacent plates 6. In operation each blade 50 sweeps out a half-turn. This arrangement is preferred where the diameter of the elements is large. In this embodiment, two trapezoidal blades are associated with each space between plates 5.

The blades 50 are driven in unison by a central mandrel 9. The mandrel 9 is provided with a top plate 52 which holds one end of the bolts 51 on which the blades 50 are mounted. The other end of each bolt 51 is fixed to an annular plate 53. In this embodiment, it is preferred to pass gas in the opposite direction to the direction of flow of gas in the embodiment shown in Figure 1 and 2.

The flame arrestor shown in Figures 5 to 7 comprises a housing in the form of a flame 20 consisting of two end members 21 and two side members 22. The flame arrestor 20 also comprises a flame barrier element, made up of elongate rectangular plates 23, and a cleaning means in the form of a series of "floating" blades 24. The blades can thus move axially with respect to each other and adopt a position centrally of each space between the plates. The arrestor further comprises two lead screws 26 each being provided at one end with a worm wheel 27 engaging a respective worm gear 29 on a mandrel 28.

The end members 21 and side members 22 of the frame 20 are held together by tie bolts 30. The flame barrier element is supported within the frame 20, the assembly of plates 23 being held tightly in place by the frame. Each plate 23 is of an elongate rectangular shape, and the end regions of each plate 23 are located in a lateral groove (not shown) provided in the inner side of each end member 21 to hold the plates. The plates are spaced-apart to define passages between them either by spacers (not shown) or by enlarged end regions of the plates. As the space between the plates is critical and should not vary across the face of the plates 23, the plates 23 should not be made too broad; instead, it is better to have a deeper stack of plates 23.

The blades 24 are held together at their end regions 25 in the manner of a comb by two bolts 31. Each blade 24 of the comb is associated with a respective passage between adjacent plates 23. The comb body has two threaded holes which receive the lead screws 26. Rotation of the mandrel 28 drives the lead screws 26, so causing the comb to travel along the lead screws 26. The flame barrier element in this embodiment as described above is situated such that the plates are generally parallel to the direction of flow of gas through the arrestor.

Each of the two embodiments described above is capable of coping with a flame velocity of 140 feet/second (43m/s) and each is capable of resisting a detonation pressure of 18psi (125 Pa) which is the typical detonation pressure of a group II gas.

Typically, the thickness of the plates of both embodiments will be about 1.25 mm and the gaps between them will be about 0.5 mm. Although the flame arrestors shown in the drawings comprise plates which define the passages, it will be appreciated that the passages could be defined between components other than plates.

CLAIMS

1. A flame arrestor comprising a housing having an inlet and an outlet, a flame barrier element defining a plurality of passages which are narrow relative to the inlet and outlet, the flame barrier element being disposed so that fluid flowing through the housing passes between the elements, and a cleaning means which is movable between adjacent elements of the assembly to dislodge material accumulated between the adjacent elements.

2. A flame arrestor according to Claim 1, wherein the cleaning means comprises a series of spaced-apart blades mounted on a carrier, each blade being associated with a respective passage.

3. A flame arrestor according to Claim 2, wherein the blades are capable of moving axially with respect to each other but are prevented from moving rotationally with respect to each other.

4. A flame arrestor according to Claim 1, 2 or 3, wherein movement of the cleaning means is controlled from outside the housing.

5. A flame arrestor according to any of Claims 1 to 4, wherein the passages are defined by spaced-apart plates.

6. A flame arrestor according to Claim 5, wherein each plate is annular, the annular plates being assembled to define a central passage which communicates with the outlet.

7. A flame arrestor according to Claim 6 when appendant to Claim 2, wherein the car-

rier of the blades is mounted centrally of the passage.

8. A flame arrestor according to Claim 6, wherein the carrier of the blades is mounted outside the flame barrier element.

9. A flame arrestor according to Claim 8, wherein there is more than one blade associated with each space between the plates.

10. A flame arrestor according to Claim 9 wherein there are two blades associated with each space between the plates.

11. A flame arrestor according to any one of Claims 2 to 10, wherein the carrier projects from the housing.

12. A flame arrestor according to any one of claims 5 to 11, wherein each blade of the cleaning means is in the shape of a parallelogram.

13. A flame arrestor according to any preceding claim, wherein operative movement of the cleaning means is a rotary motion.

14. A flame arrestor according to Claim 5, wherein the spaced-apart plates are each of an elongate rectangular shape, and are disposed generally parallel to the direction of flow of fluid through the arrestor.

15. A flame arrestor according to Claim 14, wherein the blades of the cleaning means are in the form of fingers, each blade being associated with a respective passage between adjacent plates.

16. A flame arrestor according to Claim 15 or 16, wherein the movement of the cleaning means is controlled from outside the housing by a mandrel which is geared to at least one lead screw along which the cleaning means is movable.

17. A flame arrestor substantially as described herein with reference to, and as shown in, Figures 1 and 2, Figures 1 and 2 as modified by Figure 3; or Figures 3 to 5 of the accompanying drawings.

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